Generation of Biogas in Low Density Poly Ethylene Balloon for Electricity Generation

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Abstract -The situation of our country's energy sector brings to light the need to increase the installed capacity of electrical power. In the considerations high on the agenda are the cost of generation and the environmental impact the option will have. It is on these factors that this paper has been based. The recent developments in the use of renewable energy especially Biogas Fuelled Generator is very encouraging in that it paves the way for the developments in other renewable energy sources especially biomass.
The potential of biogas in power generation is immense and is definitely an area that deserves a lot of attention. The paper has fully described the properties and uses of biogas. It has also gone a step further to look into methane which is the most important component gas of biogas with special emphasis on its heating properties and its role in the Green House Effect.
The preparation of biogas through anaerobic digestion is done in LDPE balloon that is included in the paper detailing the ranges of optimum biogas production. The effective use of Biogas is hampered due to impurities that it contains. The various impurities and the techniques used to remove them have been handled in detail.

Key Words:LDPE, Cow dung, light, Gas scrubber, electricity generation etc.

1.INTRODUCTION *(Size 11, Times New roman)*

The threat of global warming has never before been so clear as it is now. India in the past 10-20 years has seen a great reduction in the amount of rainfall it receives characterized by long spells of drought. Our dependence on hydropower has compounded the issue as the level of water in our hydroelectric dams has fallen to very low levels thus reducing their electrical power output. This has caused an energy crisis to the extent that rationing measures were introduced.

The emergency measure put in place by the government to increase our installed capacity was the increase in coal powered thermal stations. The effect has been the increase in the price of electrical energy in proportion to the rising cost of coal that has been passed down to consumers. Domestic consumers are now paying up to 250% more for electricity than they used to 3 years ago. The effect has been greater on the Industrial and Commercial consumers who have seen their operational costs rise considerably due to increasing power costs. The current situation has damaging effects on the businesses because they are now operating below capacity and is a setback to economic recovery. In addition, to balance their budgets companies will be forced to retrench workers and also avoid employing new ones. Therefore, unemployment and inevitably poverty will increase; a recipe for social unrest. Aside from the economic side of this, there is also the threat to the environment with an increase in air pollution from the fossil fuel powered thermal plants. So we tried to find solution to reduce dependency on fossil fuels by converting Power Generators to Biogas compatable.

2. Body of Paper

Biogas is produced by the fermentation of organic matter including manure, sewage sludge, and municipal solid waste, under anaerobic (having no oxygen) conditions. Biogas is gas combustible mixture consisting mainly of methane and carbon dioxide, together with several impurities.

$2CH2O \rightarrow CH4 + CO2$

Carbohydrate→ methane + carbon dioxide

Biogas with a methane content higher than 45% is flammable. It has specific properties which are listed in Table 1.1

Table -1.1: General features of biogas

Composition	55–70% methane (CH 4)
	30–45% carbon dioxide (CO 2)
	Traces of other gases
Energy content	6.0 – 6.5 kWh/ m^3
Fuel equivalent	0.60– 0.65 L oil/m^3 biogas
Explosion limits	6 – 12% biogas in air
Ignition temperature	650 – 750 ° C (with the above mentioned methane content
Critical pressure	75–89 bar
Critical temperature	82.5^{0}C
Normal density	1.2 Kg/m^3
Smell	Bad eggs due to presence of H_2S
Molar Mass	16.043 kg $kmol^{-1}$

The amount of each gas in the mixture depends on many factors as the type of digester and the kind of organic matter. The average percentage composition of each gas in the biogas mixture is given in Table 1.2.

In any way this mixture is basically made of methane (CH4) and carbon dioxide (CO2), and its heating value is straightly linked to the methane content with the average lower heat value (LHV) of 5,300 kcal/Nm^3 (22.2 MJ/Nm3),energy value of methane is 37.78MJ/Nm^3

Table -1.1: Biogas mixture composition

Methane (CH4)	66.5%
Carbon Dioxide (CO2)	30.5%
Oxygen (O2) + Nitrogen (N2)	0.5%
Humidity (H2O)	2.5%
Hydrogen sulfide (H2S)	130 ppm OR 0.01%

➢ Methane

Methane is important for electrical generation by burning it as a fuel in a gas turbine or steam boiler. Compared to other hydrocarbon fuels, burning methane produces less carbon dioxide for each unit of heat released. At about 891 kJ/mol, methane's heat of combustion is lower than any other hydrocarbon but the ratio of the heat of combustion (891 kJ/mol) to the molecular mass (16.0 g/mol) shows that methane, being the simplest hydrocarbon, produces more heat per mass unit (55.7 kJ/g) than other complex hydrocarbons. In many cities, methane is piped into homes for domestic heating and cooking purposes. In this context it is usually known as natural gas, and is considered to have an energy content of 39 mega joules per cubic meter, or 1,000 BTU per standard cubic foot.

Methane in the form of compressed natural gas is used as a vehicle fuel, and is claimed more environmentally friendly than other fossil fuels such as gasoline/petrol and diesel.

	Temp	Pressure(Bar)	Density
Critical Point	82.59^{0}C	45.98	0.162
Boiling point at 1.013 bar	-161.52^{0}C	--	0.4226
Triple Point	-182.47^{0}C	0.117	----

Methane also plays a huge role in global warming as an important Green House Gas (GHG).Global warming is the increase in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Most of the observedtemperature increase since the middle of the 20th century has been caused by increasing concentrations of greenhouse gases, which result from human activities such as the burning of fossil fuel and deforestation.

➢ Biogas to energy

Biogas is a promising renewable source of energy. It can be directly converted into electrical power, e.g., in a fuel cell. It can be burnt, releasing heat at high temperature. It can be burnt in a CHP for the simultaneous production of heat and power.

Finally, it can be fed into the natural gas network for energy saving purposes or it can serve as fuel for vehicles, being distributed by gas stations.

➢ Benefits of using biogas

1) Local, available fuel source
2) Easy to capture and use
3) Source of renewable energy
4) Constant supply - 24 hours a day, 7 days a week
5) Reliable technologies exist for using landfill gas – more than 90% up time
6) Uses a source of energy that otherwise would have been wasted
7) Helps the global environment by reducing uncontrolled emissions.

➢ Biogas preparation (Anaerobic digestion)

This is the process by which bacteria break down biodegradable substrates in anaerobic conditions (no oxygen) to produce biogas. There are a wide range of substrates that can be used for generation of biogas:

- Animal manure
- Bio waste from collections of residual waste and trade waste similar to domestic waste
- Sewage sludge and co-substrate
- Industrial waste water
- Waste grease or fat
- Wood, straw

Methane fermentation is a complex process, which can be divided up into four phases of degradation: hydrolysis, abiogenesis, acetogenesis, and methanation. The individual phases are carried out by different groups of microorganisms, with different requirements on the environment.

It is crucial that the conditions are conducive enough for the bacteria to thrive.

➢ Biogas Plants

A biogas plant is made up of the following parts:

1)Reactor: This is where the anaerobic digestion of the biodegradable substrate occurs. It can be made either of bricks, concrete or steel. The material used should be able to withstand many deoxygenating substances that substrates contain, which cause fish die - off or groundwater contamination.

As such, must be reliably tight, so that no substrates can penetrate into the groundwater. The tightness of the components, above all the connections, valves, and in particular the mechanisms for leakage recognition, must be easily and reliably controllable.

Corrosion is induced by sulfuric acid, ammonia, and nitric acid, particularly in the area where the water surface meets the wall of the bioreactor is prone to leakage if pH values are low.

In our plant we prepare plot on agricultural land by taking pit of 8m(long)*2m(wide)*1.5m (deep) for placement of LDPE i.e. Low Density Polymer Ethylene Balloon.

Fig.1.1: Pit for Balloon Placement

Fig.1.2: LDPE Balloon after Biogas Generation

- **Petrol engines (Converted to CBG)**

A Petrol engine is a closed system that converts thermal energy into mechanical energy by cyclic compression and expansion of the working fluid. The work energy can subsequently be converted into electricity using a generator. A Petrol engine can use several sources of heat, which makes it theoretically ideal for electricity generation from waste heat sources. Test engines have been run on solar heat, heat from gas, oil or biomass flames and waste heat from existing operations. As the Petrol engine uses an external combustor and all moving parts are sealed from the combustion products, unlike internal combustion engines and turbines there is no need for high quality fuel. By design, Petrol engines are quiet and should require little maintenance, which makes them attractive for remote sites or for domestic use.

Petrol engines are a technology within 1 to 5 years of commercial production, assuming they can be demonstrated to have acceptable reliability and energy conversion efficiency for their target markets. Petrol engines have several potential applications in cogeneration, conversion of waste heat to electricity and remote power generation. Beta test units are available at sizes up to 25 kW. To be effective, Petrol engines should be used in a cogeneration mode as efficiencies ofconversion from heat energy to electricity are only 15 to 25%. When used in a cogeneration system, overall energy use will be 80 to 85%. Petrol engines would be suitable for biogas applications as they do not have a requirement for pressurized fuel gas supply and should also be tolerant to moisture and corrosive gases such as hydrogen sulfide in the fuel gas

3. CONCLUSIONS

The properties of biogas and the mode of preparation were explained in great detail. The various uses of biogas were also explored to some extent giving the reader an idea of the positive effects biogas can have on our energy sector if properly exploited. The nature of methane which is the most important component of biogas was discussed especially its role as a major Green House Gas (GHG).

The various technologies that can be employed in the generation of electricity using biogas were brought out in great detail together with the most recent and least used but show great potential such as fuel cells and Petrol Engines. During the generation of power, the heat generated is usually lost to the environment but the report showed that it can be utilized further. This is discussed greatly under Combined Heat and Power and Combine Cycle systems.

After visits to the Kagal Sewage Treatment Plant, the data collected was used to analyze the possibility of a power plant using biogas from sewage sludge being constructed at the site. The results were very encouraging and the analysis showed that the power plant construction was indeed viable.

The objectives of the paper were satisfactorily met and the material can be used for reference in a study of similar biogas power plants.

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The heading should be treated as a 3rd level heading and should not be assigned a number.

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